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ABSTRACT

Simultaneous maximum likelihood procedures were used to investigate the generality of ability factor structure in adulthood and old age. Data were analyzed for 198 subjects aged 15-32; 173 subjects aged 51-67; and 153 subjects aged 68-83. Variables were 14 ability tests marking five cognitive factors: verbal comprehension, number facility, perceptual speed, symbolic cognition, and flexibility of closure. Results indicated no change in the number of factors and no important shifts in salient loadings. The magnitude of factor covariances, however, tended to increase across age groups. Such shifts were not uniform across factors, but appeared to be dependent on the properties of different factors as to whether factor covariance increases were early or late. The results indicated an increasing interdependence of intellectual functioning in late life. (Author)

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On the Generality of Ability Factor Structure Across the Adult Life-span

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Abstract

Simultaneous maximum likelihood procedures were used to investigate the generality of ability factor structure in adulthood and old age Data were analyzed for 198 young individuals (age range of 15 - 32 years), 173 younger old individuals (age range of 51 - 67 years) and 153 older-old individuals (age range of 68 - 83 years). Variables were fourteen ability tests marking five cognitive factors: Verbal Comprehension, Number Facility, Perceptual Speed, Symbolic Cognition, and Flexibility of Closure. Results indicated no change in the number of factors and no important shifts in salient loadings. The magnitude of factor covariances, however, tended to increase across age groups. Such shifts were not uniform across factors but appeared to be dependent on the properties of different factors as to whether factor covariance increases were early or late. The results indicated an increasing interdependence of intellectual functioning in late life.

The generality of ability factor structure across different age groups is a topic of considerable interest. There are two primary reasons for this. From a general scientific perspective, it is important to test the limits of applicability of structural models across various conditions, including age. Secondly, the invariance of measurement is a fundamental assumption in most age-comparative research.

A number of studies have been addressed to age-comparative structural invariance in adulthood and old age. Most of these studies have utilized the Wechsler subtests as variables for comparative analysis (Balinsky, 1941; Birren, 1952; Maxwell, 1961; Lienert & Crott, 1964; Berger, Bernstein, Klein, Cohen & Lucas, 1964; Green and Berkowitz, 1964; Radcliffe, 1966; Cohen, 1957; O'Neil, 1962; Riegel & Riegel, 1962). As many writers have pointed out (e.g., Guilford, 1967), the Wechsler subtests, by themselves, are rather poor materials for factor analysis. In a comparative factor analysis, a particularly important problem concerns the judgement of an optimal number of factors. Solutions for the Wechsler subtests often involve extracting factors with only one or two salient loadings. In such a context, the decision regarding an appropriate number of factors is rendered unusually difficult and often inconsistent across investigators and age groups. Several studies (Berger, et al, 1964; Green and Berkowitz, 1964) have interpreted changes in the number of factors as a fundamental outcome of age-comparative analyses. This kind of conclusion is problematical considering that the number of factors has varied from two (Radcliffe, 1966) to five (Balinsky, 1941)

across different age groups, with different outcomes being as plausibly attributed to differing methods across investigators as to differing ages (Riegel and Riegel, 1962).

In the previously published literature, only McHugh and Owens (1954) and Weiner (1964) used non-Wechsler materials. In the former case, the Army Alpha was used. The General Aptitude Test Battery was used in the latter. While these materials are probably slightly better regarding the number of factors, it is clearly advantageous to employ a battery of tests which have been demonstrated to have a specific number of factors in previous research.

While the issue of the number of factors is a fundamental problem with this literature, other difficulties arise as well. Most of the studies cited compared correlation matrices standardized in separate groups using the vector of standard deviations from each group. As many writers have pointed out (Jöreskog, 1971; Maxwell, 1977; Nesselroade, 1977; Cunningham, 1978), correlation matrices standardized within groups are not in general comparable. A preferred procedure that retains a uniform metric across matrices is the scaling of variance-covariance matrices for all groups utilizing a uniform vector. Such a vector could consist of the standard deviations from a reference group or of standard deviations pooled across the observed samples. The important point is that the scaling procedures must be uniform across groups (McGraw and Jöreskog, 1971). Within the substantive domain of ability variables in old age, this kind of consideration is particularly pertinent considering that many variables exhibit

markedly increased variances with age. This may be indicative of terminal decline phenomena (Siegler, 1975).

A second kind of problem with this literature is that most of the studies (Riegel and Riegel, 1962 being a notable exception) employed independent rotations to compare structures across age groups. Unfortunately, as several writers have pointed out (Meredith, 1964; Mulaik, 1972), such independent rotations will not in general identify similar structures. It is necessary to rotate to maximum similarity. If such similarity rotations are carried out and discrepancies in structure remain across groups, it is reasonable to conclude that the structures differ. This is not the case with independent rotations. A number of orthogonal and oblique Procrustes techniques have been developed to effect such rotations to similarity (e.g., Cliff, 1966). The weakness of such techniques is that they tend to capitalize on chance and therefore, Jöreskog's approach appears to be generally preferred (Jöreskog, 1971; Sörbom and Jöreskog, 1976). These procedures involve maximum likelihood hypothesis testing techniques, which are quite powerful for identifying differences in structure across groups.

A third problem with the existing literature concerns the generalizability of structural differences across different methods of attempting to identify ontogenetic change. All of the studies cited above with the sole exception of McHugh and Owens (1954) relied on cross-sectional comparisons of age groups. Since the publication of Schaie and Strother (1968) who demonstrated clear cohort (generational) differences in level of ability, it has become important to demonstrate the generality of cross-sectional age differences by using longitudinal designs (see Schaie, 1973

for more detailed discussion). Since the paper by McHugh and Owens was published long before the principles of equivalent metric and rotation to similarity were fully articulated, there was no study in the literature which yielded an unambiguous answer as to factor structure stability in late life.

With these issues in mind, Cunningham and Birren (In press) reanalyzed the longitudinal data of Owens (1953; 1966) utilizing maximum likelihood hypothesis testing techniques (Sörbom and Jöreskog, 1976). The Owens data set consisted of Army Alpha scores on 96 males tested at approximately ages twenty, fifty, and sixty, with the first testing occurring in 1919. The analysis was facilitated by an earlier, hand-rotated solution of data from a similar college sample by Guilford (1938). In comparing structures derived from the twenty- and fifty-year-olds, a simultaneous model specifying equivalent factor loading patterns for the two groups was found to be plausible, although factor covariances were importantly elevated for the highly speeded Relations Factor in the older group. An attempt to strengthen the model by specifying equivalent factor variance-covariance matrices was unsuccessful. In comparing the structure from fifty- and sixty-year-old structures, the most basic simultaneous model specifying equivalent factor loadings was rejected. Subsequent independent Promax rotations for the sixty-year-old group resulted in a factor loading pattern rather similar to the younger groups but with some shifts in factor loadings. For example, two speeded verbal tests (Common Sense and Disarranged Sentences) showed salient loadings on a Verbal factor in the

twenty- and fifty-year-old groups, but showed salient loadings only on a speeded relations factor in the sixty-year-old group. The covariance for the Verbal and Relations factor also increased importantly for the sixty-year-old's data when compared with the others.

Of considerable interest for subsequent study were the results of additional cross-generational comparisons. An additional group of 123 twenty-year-olds was tested in 1972-74. Simultaneous models were considered for each of the three structures discussed above. No simultaneous models were found plausible for the fifty- and sixty-year-old structures. However, in the time-lag comparison with data from twenty-year-olds in 1919 and twenty-year-olds in 1972-74, it was found that a simultaneous model specifying both equivalent factor loadings and factor variance-covariance matrices was found to be plausible. This finding was of considerable interest since it suggested a robust generality of factor structure across widely disparate generations and times of measurement. This outcome also strengthened an age change (in contrast to a time of measurement) interpretation of the previous longitudinal comparisons.

While the long-term longitudinal and time-lag comparisons allowed for relatively strong conclusions from a developmental design standpoint, there were several limitations to the Cunningham and Birren study. The sample sizes were modest, and the variables analyzed were dictated by opportunity rather than design. While the Army Alpha subtests possess a relatively distinct structure (Riegel, 1977), it would clearly be preferable to employ a designed battery of factor referenced tests, which had been utilized in previous studies with young adults and whose factorial structure

was understood. An additional issue not addressed by previous studies concerned the sampling of variables within the ability domains. It is well known (e.g., Guilford, 1967; Ekstrom, French and Harmon, 1976) that the Wechsler subtests span a very narrow range of abilities isolated in psychometric research. The addition of Army Alpha and GATB subtests represented a very modest broadening of the scope of age-comparative structural studies.

The research described below was designed with consideration to the issues of domain sampling of variables and subject sample size. Also, since in the Cunningham and Birren study the most significant differences in structure were obtained by contrasting the structure from the sixty-year-olds with the younger structure, an older subject range was utilized in order to focus on these differences. It was hypothesized that there would be significant differences in structure between each succeeding age group, that there would be at least some shifts in salient loadings with age, and that shifts in general would be of greater magnitude for ability factors in which speed of response was an important aspect of performance. This last hypothesis was derived from the previous study by Cunningham and Birren (In press) which suggested that qualitative differences in structure were greater for highly speeded tasks.

Method

Subjects

The younger group of subjects (YG) consisted of 234 young adults recruited through local newspaper advertisements in Gainesville, Florida. The subjects received ten dollars for taking a lengthy battery of tests. The average age was 21 years, with a range of 15 to 32 years. Educational attainment ranged from nine to eighteen years with a mean of 14 years. Forty-nine percent were males, and most were students from either Santa Fe Community College or the University of Florida. Complete data for all variables analyzed were obtained for 198 participants.

The older group consisted of 388 senior citizens recruited through mailing invitations to members of the American Association of Retired Persons (AARP) in Cocoa, Hollywood, Jacksonville, Lake City, Madeira Beach, Melbourne, Orlando, Pensacola, Pinellas Park, Sarasota, Tampa, and Tarpon Springs, Florida. Recruitment by AARP local chapter presidents supplemented the recruitment by mail. Participants were paid five dollars to take about two hours of ability tests. Ages ranged from 51 - 83 years. As is usual with elderly samples, the majority (60 percent) were female. The average education was 12 years with a range of four to twenty years. Complete data for the variables analyzed were obtained for 326 participants. For the purpose of the data analysis, this sample was divided at the median age into a younger-old group (YOG) and an older-old group (OOG). The YOG ranged in age from 51 - 67 years (n = 173) and the OOG ranged in age from 68 - 83 years (n = 153).

Variables

The young sample received a battery of 32 tests hypothesized

to mark eleven factors. The test names, their hypothesized factor, the source, and the order of administration are indicated in Table 1. The tests were administered in a long session

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Insert Table 1 about here

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beginning at 9:00 a.m. and ending at 2:00 p.m. Two ten-minute breaks were allowed in the morning and an hour was allowed for lunch. For all tests, the standard instructions were used.

The older participants received a shorter battery consisting of V5, N1, P2, DW, CF31, CF32, N2, N3, OM1, OM2, CF2, P1, V41, and V42 in that order. The tests were selected to mark factors of Verbal Comprehension (V), Number Facility (N), Perceptual Speed (P), Symbolic Cognition (SC), and Flexibility of Closure (CF). (The other tests listed in Table 1 were administered to other elderly groups and these results will be reported elsewhere). The testing sessions for the elderly sample always began at 9:30 a.m., usually in the local meeting place of the AARP in the various cities.

One of the limitations of the Cunningham and Birren (In press) data analysis was the use of the factorially complex subtests of the Army Alpha. One of the key objectives of the current project was to consider factorial stability with very narrowly defined factors. The factors to be investigated were selected in terms of previous replications (French, Ekstrom & Price, 1963), and tests were selected so as to yield narrow, tight clusters of variables within factors. This was done partly to guarantee a definite number of factors in the YG, and also to determine if

possible structural variations such as factor fusion or shifts in major loading patterns occurred in such a battery.

With regard to variable ordering in different groups, Kamin's work (1957) suggested that order effects were negligible. By inference, Furry and Baltes' (1973) results raised the possibility that fatigue effects might be an important source of bias, but subsequent work (Cunningham, Sepcoski, and Opel, 1978) indicated that even batteries somewhat longer than those administered to the current sample of elderly participants did not yield fatigue effects.

From a practical viewpoint of recruiting participants, it was important to limit the time commitment required. In order to obtain reliable, multiple indicators for several factors in a relatively short period of time, it was decided to resort to the use of separately timed, parallel tests to be used as separate variables. Although this effected a useful economy of time requirements, it resulted in rather narrow factor definitions and resulted in some potential mixing of common and specific variance in the factor model. Cronbach (1970) has pointed out that this traditional distinction has been less emphasized in recent factor analytic work. However, a technical innovation due to Sörbom (1975; Sörbom and Jöreskog, 1976) allowed for consideration of factor analytic models in which specific variance was allowed to be correlated across certain pairs of variables. The details of this procedure are described below.

Data Analysis and Results

Preliminary analysis in the young adult group. In order to generate plausible fixed values to achieve a determined model

in subsequent analyses, a preliminary analysis for the thirty variables (EG and MP were dropped due to low reliability) in the young adult group (YG) was carried out using the EFAP program (Jöreskog and Sörbom, 1976). Ten factors were rotated utilizing Varimax and Promax criteria. With regard to the appropriateness of the number of factors, a $\chi^2_{180} = 191.19$, $p = .27$ with a Tucker reliability coefficient (TRC) of .99, was obtained for the ten factor solution. Thus the hypothesis that the number of factors equaled ten appeared plausible. The simple structure in the Varimax solution was very satisfactory, though not quite as "clean" as the Promax solution. Bearing in mind the considerable advantages in terms of rapid and therefore relatively inexpensive convergence in subsequent simultaneous analyses, the Varimax solution was selected as a basis for the remaining analyses. Also, since it was anticipated that increased factor covariances would be found in the older group, the interpretation of such increases would be considerably simplified by an orthogonal base solution.

A COFAMM analysis (Sörbom and Jöreskog, 1976) was carried out on the YG data for the fourteen variables administered to the elderly samples. One objective of this analysis was to allow for correlated error in the three pairs of tests which were parallel forms (V41, V42, OM1, OM2, CF31, CF32). A second objective was to fix a sufficient number of parameters in the model to achieve a determined solution (Sörbom, 1975). In order to accomplish this, it was necessary to fix some parameters using as a basis the initial Varimax solution. One high load-

ing from each of the five factors (hypothesized in the shorter battery given to the older samples) was fixed in the factor loading matrix (Λ). In addition, thirteen loadings of less than .10 were fixed at zero. These values are indicated in Table 2. However, in order to avoid possible distortions in

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Insert Table 2 about here

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the estimation of correlated error values, no loadings for the parallel-form tests listed above were fixed. The factor variance-covariance (Φ) matrix was fixed with unities in the main diagonal and zeros in the off-diagonal. A modified specificity matrix (Ψ) was used to allow for correlated error in the parallel test pairs. The resulting $\chi^2_{37} = 52.48$, ($p = .0374$) indicated a reasonable fit of the data to the model. (The chi-square test utilized is very powerful. Probability values greater than .01 were interpreted as indicating a plausible model. See Jöreskog, 1971; and also Olsson and Bergman, 1977 for a discussion of these issues).

Simultaneous analysis in the young and younger old groups. Next, taking advantage of the preliminary analyses carried out on the young sample, a simultaneous analysis was carried out comparing covariance structures in the YG and the YOG. The Λ pattern previously obtained for the YG was fixed for both groups. The Φ matrix for YOG was unconstrained. For the YG group, the off-diagonal elements of the Φ matrix were fixed at zero, but the main diagonal elements were left unconstrained. Off-diagonal Ψ parameters were allowed for the parallel tests as before. The resulting $\chi^2_{156} = 192.692$ ($p = .0244$) indicated

a plausible model. The parameters are shown in Table 2. Correlated specificity was negative in parameter 2,3 in the YG group (-.014), although the value was very close to zero. This was counter-intuitive, but is an acceptable outcome. Unrestrained factor covariances ranged from -.053 to .515 in the YOG.

Other possible constrained models were considered. The first of these restrained the off-diagonal elements of the Φ matrix in the YOG to zero. Thus, both YG and YOG models contained orthogonal factors. The other characteristics of the model were as described in the last analysis. The obtained $\chi^2_{166} = 277.322$ ($p = .0000$). This model was therefore rejected. A second model was considered in which the off-diagonal elements of the Φ matrices in both YG and YOG were constrained to be equivalent in a pairwise fashion, though not necessarily orthogonal. This analysis yielded a $\chi^2_{156} = 248.453$ ($p = .0000$). Thus neither attempt to strengthen the model by additional constraints on the Φ matrix resulted in plausible outcomes.

Simultaneous analysis in the younger old and older old groups. The next step was to consider a simultaneous model for the YOG and OOG groups. All factor loadings were constrained to the values obtained from the first YG-YOG analysis. These values are indicated in Table 2. The Φ matrices were unconstrained. A modified Ψ matrix was employed as in the previous analyses. The resulting $\chi^2_{146} = 272.106$ ($p = .0000$). Thus, the model incorporating a factor loading pattern previously found plausible in both YG and YOG was rejected in OOG.

Analyses within the older old group. In order to explore fur-

ther the structure in the OOG, independent analyses were carried out within that group. The first possibility considered was that the number of factors may have shifted in the OOG group. Three through seven factors were considered. The relevant statistics obtained are presented in Table 3.

Insert Table 3 about here

At five factors, the hypothesis of a diagonal residual matrix could not be rejected. Thus, a five-factor solution appeared plausible in OOG.

Next an exploratory analysis using both Varimax and Promax rotations was carried out in the OOG. The simple structure in the Varimax solution was unsatisfactory, yielding only eleven (of seventy) λ values less than .10. The Promax solution was therefore accepted as a basis for the subsequent COFAMM analysis.

The final COFAMM analysis was carried out primarily in order to incorporate a modified Ψ matrix as described above. The model involved fixing one high λ value for each factor from the previous analysis and also all λ values of less than .10 at zero. However, no values from parallel forms were fixed, in order not to artificially constrain variance from being absorbed into the modified Ψ matrix. The main diagonal of this matrix was constrained to contain unities, but was otherwise free. This model resulted in a $\chi^2_{35} = 45.461$ ($p = .1109$), which appeared plausible. The detailed results are presented in Table 4.

Insert Table 4 about here

Discussion

The findings were consistent with the hypothesis of differences in factor structure with age. Although these differences appear to be highly reliable from a statistical standpoint, the general pattern of loadings was quite similar across the various age groups as shown in Tables 2 and 4. This finding underscores a considerable generality of construct validity across age groups. This consistency of construct validity is quite surprising in view of the tendency for both variances and covariances (at the variable and factor level) to increase with age. Thus, apparently in spite of considerable shifts in different aspects of the data, the fundamental character of the test instruments remained the same, as portrayed in the pattern of factor loadings.

Another aspect of stability in the results was that the number of factors remained the same. This is in contrast to a number of previous studies, reviewed in the introduction, that concluded that shifts to a smaller number of factors occurred with age. The writer was somewhat suprised by this outcome, but given the careful selection of the five factors and the associated tests, the conclusion of stability for the number of factors can be more confidently interpreted than has been the case in factor analyses of the Wechsler subtests in the earlier literature.

Although the number of factors remained the same, the dependencies among factors increased importantly from the YG to the OOG. An orthogonal model was quite plausible for the

YG, but was found implausible for the older groups. In comparing the YG to the YOG, most factor covariances were found to increase importantly, except for the Cognitive Flexibility factor, which remained virtually orthogonal to the other factors. The degree of increase in the other factor covariances varied widely, from .034 to .515, with a median increase of .360. In the OOG, the covariances were generally higher, with Cognitive Flexibility becoming more highly related to the other factors. In general, the factor covariances were slightly elevated in the YOG and elevated to a larger extent in the OOG (median covariance equal to .428). The magnitude of these increases in factor covariances was not as great as found in the Cunningham and Birren study. This outcome may be a function of the more complex test materials employed in the previous study.

Generally, the covariances in both the YOG and OOG were slightly higher for the Perceptual Speed factor than for other covariances between other factors. This finding lends some modest support to the previous interpretation by Cunningham and Birren that highly speeded variables may show greater covariance shifts with age in contrast to variables which are less highly speeded.

In terms of the dedifferentiation hypothesis (Rienert, 1970), it is of some interest that the number of factors remained stable and also that the pattern of increased covariances was not uniform across different factors. First, the Cognitive Flexibility factor remained relatively orthogonal in the YOG and only became importantly related to the other factors in the oldest group. Second, the Perceptual Speed

factor appeared to be relatively more highly related to other factors. As Rienert has noted, dedifferentiation is a relatively simplistic model, and these results suggest that greater articulation of this hypothesis may be necessary. Such a further articulation could consist of relating functional properties of the intellectual tasks (such as speededness) to greater or lesser magnitude of covariance shift. Also with regard to Cognitive Flexibility, consideration should be given to early versus later manifestations of increased covariances.

The dedifferentiation hypothesis is often discussed as a simplification of the structure of abilities with age. Although it is a subtle point, the indication from the current findings is that it is less an issue of simplification of structure so much as it is an increasing interdependence of different aspects of intellectual functioning. Two prominent candidates for a mechanism to explain such increasing dependencies are intellectual speed and health/terminal decline phenomena. Research intended to better evaluate the former hypothesis would probably require more factors and variables marking different aspects of cognitive speed in a more systematic fashion than is afforded by the current effort. The latter possible mechanism would probably best be explored with longitudinal data, preferably with quantitative indices of health status (e.g., blood pressure). Ideally, such a study would be carried out with data for subjects that are already deceased, so that distance from death could be introduced as an explicit variable to define groups, rather than age. Similarly, return-

ing to the speed hypothesis, it might be constructive to form groups in terms of Perceptual Speed scores as well as age and reconsider factor structure differences in that context.

One of the primary conceptual motivations for the present research was the possibility that construct validity of ability measures might change substantially in late life. The finding of several shifts in salient loadings in the Cunningham and Birren study, together with the suggestion made by many reviewers that tests developed for young people might not reflect the mature capacities of aged individuals raised the possibility that the psychological meaning of some or many test scores might change in important ways among elderly samples. If it was found that dramatic differences in the number of factors or in salient loadings was associated with age, it would suggest the need for new and special tests for the elderly. The fact that variances and covariances among variables increased with age underscored the plausibility of this outcome. The results reported here, however, indicate surprising stability of construct validity as reflected in the factor loading patterns obtained. This outcome suggests that special intelligence tests for the elderly may not be needed. On the other hand, the finding of increased factor covariances with age represents an apparently reliable group variation with age and an interesting domain for further theoretical and empirical study.

Table 1

Test Instruments and Procedural Information

Test Name[a]	Abbreviation	Factor[b]	Source[c]	Order
Advanced Vocabulary	V5	V	ETS	1
Advanced Vocabulary 1	V41	V	ETS	23
Advanced Vocabulary 2	V42	V	ETS	24
Addition	N1	N	ETS	2
Division	N2	N	ETS	18
Subtraction and Multiplication	N3	N	ETS	19
Number Comparison	P2	P	ETS	3
Finding A's	P1	P	ETS	5
Letter Comparison	P4	P	UF	14
Word Arrangement	WA	Fe	G(ETS)	4
Simile Interpretation	SIM	Fe	G(ETS)	10
Expressional Fluency	EXF	Fe	G(ETS)	13
Prefixes I	PRE I	Fw	UF	6
Prefixes II	PRE II	Fw	UF	7
Suffixes	SUF	Fw	UF	12
Identical Pictures 1	P31	FiE	ETS	8
Identical Pictures 2	P32	FiE	ETS	9
Judgement of Size	JOS	FiE	G	11
Disemvoweled Words	DW	SyC	G	15
Omelet 1	OM1	SyC	G	20
Omelet 2	OM2	SyC	G	21
Copying Test 1	CF31	Cf	ETS	16
Copying Test 2	CF32	Cf	ETS	17
Hidden Patterns CF2	CF2	Cf	ETS	22
Pertinent Questions 1	PQ1	Sep	G	27
Pertinent Questions 2	PQ2	Sep	G	28
Seeing Problems	SP	Sep	G	32
Gestalt Transformations 1	GT1	Re	G	29
Gestalt Transformations 2	GT2	Re	G	30
New Uses	NU	Re	G	31
Expression Grouping	EG	SI	G	25
Missing Pictures	MP	SI	G	26

Notes. a. When a number follows a test name, it indicates that two scores were obtained from separately timed parts of the test.

b. The factor abbreviations follow the ETS system (French, Ekstrom and Price, 1963), except for SI, which was hypothesized to be a complex Social Intelligence factor, SYC, which was hypothesized to be a complex Symbolic Cognition factor, and FiE which was hypothesized to be a Perceptual Speed factor with figural content, hence Figural Evaluation.

c. ETS stands for Educational Testing Service Manual, Kit of Reference Tests for Cognitive Factors (French, Ekstrom and Price, 1963). UF indicates an unpublished test developed at the University of Florida by the author, while G indicates a test developed in the Guilford Structure of Intellect Project and published by Sheridan Psychological Services, Inc., P.O. Box 6101, Orange, CA 91617. G(ETS) indicates a Guilford test listed in the ETS Manual.

Table 2

Results of the Simultaneous Analysis of the Younger and Younger Old Samples.

Factor Loading Matrix (λ)

	I	II	III	IV	V
V5	.824*	.0*	.0*	.274*	.0*
V41	.801*	-.129*	-.046*	.289*	.034*
V42	.867*	-.039*	.039*	.165*	.055*
N1	.0*	.848*	.164*	.125*	.0*
N2	.0*	.721*	.073*	.308*	.108*
N3	.0*	.928*	.131*	.102*	.0*
P2	.0*	.501*	.723*	-.029*	.397*
P1	.0*	.316*	.356*	.258*	.0*
DW	.156*	.129*	.391*	.623*	-.227*
OM1	.123*	.097*	.337*	.637*	-.139*
OM2	.178*	.169*	.380*	.493*	-.202*
CF31	.058*	.020*	.003*	.553*	.539*
CF32	.149*	.047*	.125*	.578*	.577*
CF2	.0*	.225*	.0*	.527*	.495*

Factor Covariance Matrix (Φ)

YG	I	II	III	IV	V
I	.666				
II	.0*	.795			
III	.0*	.0*	.916		
IV	.0*	.0*	.0*	.835	
V	.0*	.0*	.0*	.0*	.901

YOG	I	II	III	IV	V
I	1.314				
II	.515	1.159			
III	.403	.034	.639		
IV	.361	.287	.360	.755	
V	-.053	-.001	-.071	.055	.604

Specificity Matrix (Ψ)

	1,1	2,2	2,3	3,3	4,4	5,5	6,6	7,7	8,8	9,9	10,10
YG	.172	.170	-.014	.218	.156	.297	.110	.074	.695	.331	.378
YOG	.300	.299	.010	.182	.295	.385	.112	.318	.682	.359	.478

	10,11	11,11	12,12	12,13	13,13	14,14
YG	.096	.453	.534	.314	.476	.253
YOG	.125	.448	.344	.120	.336	.684

* Fixed Parameter

Table 3

Statistics on the Number of Factors in the Older Old Group.

Number of Factors	Degrees of Freedom	Chi-square	P	TRC[1]
3	52	203.0410	.000	.814
4	41	83.6379	.000	.933
5	31	43.2967	.070	.975
6	22	16.4141	.795	1.016
7	14	5.5604	.976	1.039

1. Tucker Reliability Coefficient

Table 4

Results of the COFAMM Analysis in the Older Old Group (χ^2_{35} = 45.461, p = .1109).

Factor Loading Matrix (λ)

V5	.940*	.0*	.0*	.0*	.0*
V41	.914	-.033	-.108	.260	-.076
V42	.922	-.102	-.078	.171	.023
N1	.0*	.667*	.453	-.242	.0*
N2	.0*	.673	-.206	.236	.314
N3	.0*	.938	.0*	.0*	.0*
P2	.0*	.0*	.907*	.0*	.0*
P1	.0*	.0*	.327	.265	.0*
DW	.188	.157	.0*	.430*	.177
OM1	.088	.113	-.039	.690	.076
OM2	.278	-.069	.094	.757	-.205
CF31	-.012	-.036	.009	.069	.620
CF32	-.039	.076	.014	-.105	.808
CF2	.167	.0*	.0*	.0*	.606*

Factor Covariance Matrix (Φ)

	I	II	III	IV	V
I	1.0				
II	.389	1.0			
III	.387	.605	1.0		
IV	.359	.422	.617	1.0	
V	.565	.435	.535	.411	1.0

Specificity Matrix (Ψ)

1,1	2,2	2,3	3,3	4,4	5,5	6,6	7,7	8,8	9,9	10,10
.141	.139	-.010	.126	.227	.263	.139	.153	.705	.410	.339

10,11	11,11	12,12	12,13	13,13	14,14
.163	.282	.570	.174	.338	.402

* Fixed Parameter

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Footnotes

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2. Requests for reprints should be sent to the Psychology Department, University of Florida, Gainesville, Florida. 32611.